

## Problem Set 7 : Logic

*Due 03/16/04*

As usual, think about all problems, and come up with some ideas about how to solve them. Then choose one or two of the problems and write up a careful solution.

**Knights and Knaves.** On a certain island, all of the inhabitants are either "knights," who always tell the truth, or "knaves," who always lie.

Warm up questions:

- a) If you ask an islander, "Are you a knight or a knave?" what will they say?
- b) If you meet a person on this island who says, "I am a knave," are they an islander or a visitor?

1. On your way to the island's ice cream stand, you encounter a fork in the road. You know that the ice cream stand is either to the left or to the right, but you can't remember which. You stop a passing islander to ask directions, but she is in a hurry and only has time to answer one question. You're not sure whether she is a knight or a knave. What one question can you ask her to find the way to the ice cream stand?
2. You are introduced to three people on the island, Alicia, Bernice, and Carl. You know that one is a knight, one is a knave, and one is a visitor to the island, who sometimes lies and sometimes tells the truth. During your conversation, Alicia tells you that she is a visitor. Bernice tells you that Alicia and Carl sometimes tell the truth. And Carl tells you that Bernice is a visitor. Who is who?
3. Islander A, in the presence of islander B, said "At least one of us is a knave". Is A a knight or a knave? How about B?
4. What is the greatest amount of American money that you could have, in pennies, nickels, dimes, and quarters, such that you still could not make up an even dollar?
5. Three people stand in a circle with their eyes closed. A hat is placed on each of their heads. Each hat is either red or black in color, and all three players know this. They all open their eyes simultaneously, and each player who sees a red hat is to raise a hand. The first player to then be able to correctly identify the color of his/her own hat will win a prize.
  - (a) With this setup, what will happen if two hats are red and one is black?
  - (b) Do an analysis of the last problem in which we assume that each player wears a red hat.
6. Six people, named A,B,C,D,E,F, are in the dining car of a train. They are one each from New York City, Chicago, Tulsa, St. Louis, Milwaukee, and Atlanta. The following facts are known:
  1. A and the man from New York City are physicians.
  2. E and the woman from Chicago are teachers.

3. The person from Tulsa and C are engineers.
4. B and F are veterans of the Gulf war, but the person from Tulsa has never served in the military.
5. The person from Milwaukee is older than A.
6. The person from Atlanta is older than C.
7. At St. Louis, B and the man from New York get off.
8. At San Francisco, C and the man from Milwaukee gets off.

Match the names of the people with their professions and their cities.

7. There are five houses in a row (west to east), each of a different color and inhabited by people of different nationalities, with different pets, driving different automobiles, and enjoying different beverages.

1. The English family lives in the red house.
2. The Spanish family drives the Prism.
3. Espresso is drunk in the green house.
4. The Ukrainians drink iced tea with lemon.
5. The green house is immediately east of the white house.
6. The family who owns the gerbil drives the Saturn.
7. The cat owners live in the yellow house.
8. Skim milk is drunk in the middle house.
9. The Norwegian family lives in the most westerly house.
10. The dog owners live next to the people who drive the Miata.
11. The cat lives in the house next to the people who drive the Corvette.
12. The pony owners drink grapefruit juice cocktail.
13. The Japanese family owns a chimpanzee.
14. The Norwegian family lives next to the blue house.

Who drinks the hot chocolate? And who owns the Infiniti?